Development and Validation of a Cardiopulmonary Resuscitation (CPR) Questionnaire for Knowledge, Critical Thinking, and Skills Assessment

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ABSTRACT
Cardiopulmonary Resuscitation (CPR) is a critical life-saving skill that requires knowledge, critical decision-making and skills. Assessing these competencies through reliable and valid tools is essential for evaluating training outcomes and ensuring preparedness of learners. This study aimed to test the reliability and validity of a newly developed CPR questionnaire consisting of three sections: Knowledge (10 items), Critical Thinking (10 items), and Skill Development (10 items). Data were collected from 60 participants and analyzed using Kuder-Richardson Formula-20 (KR-20) and test-retest method for dichotomous items, Cronbach's alpha for Likert-type items, item analysis (difficulty and discrimination indices), Kaiser-Meyer-Olkin (KMO) for construct validity, and inter-scale correlations for convergent validity. Results showed high reliability coefficients across all sections (Knowledge KR-20 = 0.945, Knowledge (test-retest method) = 0.97, Critical Thinking KR-20 = 0.925, Critical Thinking (test-retest method) = 0.99, and Skill Development α = 0.967). Item analysis indicated moderate to high difficulty with strong discrimination indices, and no item was flagged for poor performance. The Skill Development scale showed acceptable sampling adequacy (KMO = 0.717) with evidence of strong inter-item correlations. Convergent validity was supported by strong correlations between Knowledge, Critical Thinking, and Skill scales (r = 0.84–0.94). The study concludes that the CPR questionnaire is a highly reliable and valid instrument for measuring CPR competencies. Recommendations include maintaining the items, revising overly easy critical thinking questions, and reducing redundancy in the skill section for efficiency.
Keywords: *Cardiopulmonary Resuscitation (CPR), Knowledge, Critical Thinking, Skills, Reliability*

INTRODUCTION

Cardiopulmonary resuscitation (CPR) is universally recognized as a critical life-saving intervention, and the survival of individuals experiencing cardiac arrest largely depends on the timely and correct application of CPR by bystanders, healthcare professionals, or trained volunteers. Despite its proven effectiveness, evidence consistently shows widespread gaps in CPR knowledge, decision-making, and confidence in performing skills (Meaney et al., 2013; Perkins et al., 2021). International guidelines emphasize that CPR training must extend beyond the transfer of factual knowledge to include the development of critical thinking for emergency decision-making and hands-on competence in chest compressions, airway management, and rescue breathing. However, research indicates that even after

formal training, the retention of CPR knowledge and psychomotor skills declines rapidly, often within weeks to months (Anderson et al., 2019; Cheng et al., 2020). This decline highlights the need for robust assessment approaches capable of capturing true competency levels and guiding improvements in instructional methods.

In many academic, community, and professional training settings, structured questionnaires are widely employed to evaluate CPR-related competencies. Yet, without a rigorous psychometric foundation, these instruments may lack reliability and validity, leading to inaccurate or incomplete interpretations of learners' preparedness. Tools that are weakly validated may overlook essential aspects of CPR performance, such as the ability to make appropriate decisions under pressure, or they may overestimate readiness by focusing too heavily on factual recall. Consequently, psychometrically sound instruments are indispensable for advancing CPR education and ensuring that assessments provide meaningful insights into learners' readiness to perform in real-life situations.

Although CPR training programs are commonly implemented, comparatively fewer studies have examined the measurement properties of the assessment tools used within these programs. Many available instruments originate from guidelines or training manuals but are rarely subjected to systematic evaluations of reliability, internal consistency, or validity, including construct, content, or convergent validity. The absence of such evidence limits the ability of researchers and educators to draw accurate conclusions about the effectiveness of training interventions or to compare outcomes across different learner groups.

The present study addresses this gap by conducting a comprehensive psychometric evaluation of a CPR questionnaire designed to assess three essential domains of competency: factual knowledge of CPR procedures and guidelines; critical thinking and decision-making in emergency scenarios; and self-reported preparedness and confidence related to CPR skill performance. By examining the reliability of the instrument, analyzing item-level characteristics, and exploring the validity of the constructs measured, the study provides evidence that can strengthen the use of this tool in training, educational research, and program evaluation. Through this examination, the study contributes to developing more accurate and meaningful approaches for assessing CPR competency and offers valuable insights for enhancing the quality of CPR education.

METHODS

The study employed a psychometric evaluation design based on cross-sectional data collected through the CPR questionnaire. Data were gathered between January and March 2025, a period during which participants had completed instructional sessions on basic life support and CPR procedures. The sample consisted of 60 respondents, selected through a convenience sampling method from an educational institution where CPR training modules were regularly integrated into the curriculum. All participants had prior exposure to CPR demonstrations or instructional content. The sample included undergraduate students aged 18–35 years. Participation in the study was voluntary, and informed consent was obtained from all respondents. Ethical approval for the study was granted by the Institutional Ethics Committee of P. R. Government Girls Degree College, Etawah, ensuring adherence to research principles related to confidentiality, voluntary participation, and data protection.

Data were collected using a self-developed CPR questionnaire created to assess three domains essential to CPR competency: knowledge, critical thinking, and skill-related confidence. The instrument consisted of thirty items in total. The knowledge section included ten multiple-choice questions scored dichotomously, with one point assigned for each correct response. The critical thinking section also contained ten multiple-choice items based on situational scenarios requiring appropriate decision-making; these items were similarly scored as correct or incorrect. The skill development section consisted of ten statements evaluated on a five-point Likert scale ranging from very poor to excellent, reflecting respondents' self-perceived preparedness and confidence in performing CPR-related tasks. The questionnaire's format allowed for efficient assessment of factual understanding, reasoning in emergency contexts, and self-reported competence.

After data collection, responses were entered into Excel and imported into Power BI for statistical analysis. Prior to analysis, the dataset was checked for incomplete entries and coding accuracy. Reliability of the questionnaire was examined using widely accepted indices. For the two

dichotomous sections (knowledge and critical thinking), reliability was assessed using the Kuder–Richardson Formula 20 (KR-20), a statistical coefficient that measures internal consistency by evaluating how consistently respondents answered items intended to assess the same construct. In addition, a test–retest reliability procedure was performed, wherein a small subset of respondents completed the questionnaire again after a two-week interval to ensure the stability of responses over time. For the Likert-based skill development section, reliability was evaluated using Cronbach's alpha, a measure that indicates how closely related the items are within a scale. Higher values of both KR-20 and Cronbach's alpha suggest stronger reliability and greater internal coherence of the instrument.

To examine the quality of individual items, an item analysis was conducted. The difficulty index was computed for each dichotomous item to determine the proportion of respondents who answered correctly. Items with moderate difficulty were considered most effective in distinguishing between high and low performers. The discrimination index, evaluated through point-biserial correlation, was used to assess how well each item differentiated between respondents with higher overall scores and those with lower scores. Items with stronger discrimination values were considered more effective indicators of the intended construct. Additionally, item–total correlations were examined to determine how each item contributed to the overall scale. Items with low correlations were flagged as potentially requiring revision to improve consistency.

Validity assessments were conducted to ensure the questionnaire accurately measured the intended CPR-related constructs. Construct validity was examined using the Kaiser–Meyer–Olkin (KMO) measure, which evaluates whether the dataset is suitable for factor analysis; higher KMO values indicate that underlying patterns in the data align with the structure of the instrument. Convergent validity was evaluated by analyzing Pearson's correlations among the total scores of the knowledge, critical thinking, and skill domains. Strong positive correlations indicated that the three domains were related as expected, supporting the theoretical coherence of the questionnaire.

RESULTS

The analysis of the CPR questionnaire showed that the instrument performed consistently well across all domains and demonstrated strong psychometric properties. **For accessing the reliability of the questionnaire** KR-20 and test - retest method was applied to dichotomous scales (Knowledge and Critical Thinking about CPR) and Cronbach's α was computed for Skill Development about CPR.

Table 1. Reliability coefficients for CPR questionnaire domains

Scale	No. of Items	Reliability Coefficient
Knowledge (KR-20)	10	0.945
Knowledge (test-retest method)	10	0.97
Critical Thinking (KR-20)	10	0.925
Critical Thinking (test-retest method)	10	0.99
Skill Development (Cronbach's α)	10	0.967

Table 1. clearly indicate that overall reliability was high, indicating that the items within each domain measured their intended concepts with stability and internal coherence. The consistently high coefficients suggest that respondents understood the items clearly and responded in a manner that reflected meaningful differences in CPR competence.

Table 2. Item Analysis – Knowledge about CPR

Item	N	Mean (Difficulty p)	SD	Min	Max	Discrimination (r_pb)	Corrected Item–Total r
K1	60	0.62	0.49	0	1	0.78	0.79
K2	60	0.55	0.50	0	1	0.80	0.82
K3	60	0.60	0.49	0	1	0.81	0.84
K4	60	0.63	0.49	0	1	0.76	0.78
K5	60	0.58	0.50	0	1	0.80	0.81
K6	60	0.61	0.49	0	1	0.77	0.80
K7	60	0.59	0.49	0	1	0.79	0.82
K8	60	0.57	0.50	0	1	0.75	0.77
K9	60	0.61	0.49	0	1	0.80	0.82
K10	60	0.59	0.49	0	1	0.78	0.80

A review of individual item behaviour further supported the strength of the instrument. Table 2. related to knowledge items showed moderate levels of difficulty, meaning that they were neither too simple nor overly challenging for the participants. This balance is important because it ensures that the tool can differentiate effectively between individuals with varying levels of understanding. Items also showed strong discrimination, indicating that they successfully distinguished high performers from lower performers, reinforcing their appropriateness for competency assessment.

Table 3. Item Analysis – Critical Thinking about CPR

Item	N	Mean (Difficulty p)	SD	Min	Max	Discrimination (r_pb)	Corrected Item–Total r
C1	60	0.75	0.43	0	1	0.71	0.70
C2	60	0.80	0.40	0	1	0.70	0.72
C3	60	0.77	0.42	0	1	0.72	0.71
C4	60	0.74	0.44	0	1	0.69	0.70
C5	60	0.76	0.43	0	1	0.71	0.73
C6	60	0.78	0.41	0	1	0.70	0.72
C7	60	0.79	0.41	0	1	0.71	0.71
C8	60	0.74	0.44	0	1	0.69	0.70
C9	60	0.77	0.42	0	1	0.72	0.71
C10	60	0.76	0.43	0	1	0.70	0.72

Table 3. related to the Critical Thinking items appeared somewhat easier for respondents, which may reflect recent exposure to CPR demonstrations or scenario-based learning. Although easier, these items still showed good discriminative strength, suggesting that even familiar scenarios were effective in separating learners with stronger decision-making skills from those who require further training.

Table 4. Item Analysis – Skill Development about CPR

Item	N	Mean	SD	Min	Max	Corrected Item–Total r
S1	60	4.20	0.80	2	5	0.87
S2	60	4.25	0.75	2	5	0.88
S3	60	4.10	0.85	1	5	0.86
S4	60	4.15	0.82	2	5	0.88
S5	60	4.18	0.81	2	5	0.87
S6	60	4.22	0.79	2	5	0.88
S7	60	4.19	0.83	1	5	0.87
S8	60	4.16	0.80	2	5	0.86
S9	60	4.21	0.78	2	5	0.88
S10	60	4.23	0.79	2	5	0.87

For the Skill Development section **Table 4**, respondents generally reported high levels of confidence across all items, which is expected following structured CPR training. The consistency of these responses, along with strong item–total correlations, suggests that the scale measured a unified underlying construct related to perceived CPR readiness. The high scores may also indicate that participants felt better prepared after training, which aligns with the purpose of introductory CPR education.

Table 5. Inter-scale correlations (Pearson's r)

	Total_K	Total_C	Total_S
Total_K	1.000	0.915	0.844
Total_C	0.915	1.000	0.943
Total_S	0.844	0.943	1.000

Table 5. reported that convergent validity was supported by strong, positive correlations among the three domains of the questionnaire—Knowledge, Critical Thinking, and Skill about CPR. The construct validity results indicated that the dataset was suitable for factor-based analysis, reflecting a coherent pattern of responses. Additionally, the strong relationships among knowledge, critical thinking, and skill confidence scores confirmed that these domains are interconnected components of CPR competence. These correlations show that individuals who understand CPR procedures well also tend to make better emergency decisions and feel more confident performing skills—supporting the theoretical foundation upon which the instrument was developed.

Taken together, the results demonstrate that the questionnaire is a robust measure of CPR competencies. It reflects not only the factual and cognitive aspects of CPR but also the confidence and perceived preparedness learners carry after training. The findings suggest that the instrument can be used reliably in educational and research contexts to evaluate CPR training outcomes and identify areas requiring further instructional attention.

DISCUSSION

The findings of this study indicate that the CPR questionnaire is a strong and dependable instrument for evaluating the essential components of CPR competence. The consistently high reliability values across all three domains suggest that the questionnaire measures knowledge, reasoning, and skill confidence with internal consistency and stability. Rather than reflecting random variation or inconsistent understanding, the responses show a clear and coherent pattern. This is an important characteristic in competency-based assessments, where the objective is to distinguish between individuals who grasp CPR concepts well and those who require additional training. The high internal coherence of items also reinforces the clarity and relevance of the content included in the instrument.

The analysis of item functioning further strengthens confidence in the tool's measurement quality. Knowledge items displayed a moderate level of difficulty, which is desirable in educational evaluation because it enables both stronger and weaker learners to be meaningfully distinguished. Critical Thinking items, on the other hand, appeared easier for many participants, likely reflecting the structured training experiences they recently received. Although these items still showed strong discrimination, the relative ease suggests that future refinements could incorporate more complex or nuanced scenarios to capture a broader range of decision-making abilities. The consistently high item–total correlations across domains highlight that each item contributed effectively to the overall scale, indicating that the content of the questionnaire aligns well with the intended constructs.

Validity outcomes also support the robustness of the instrument. The dataset demonstrated adequate sampling adequacy for factor-based interpretation, confirming that the patterns of responses were coherent and suitable for construct evaluation. Additionally, the strong correlations among knowledge, reasoning, and skill confidence suggest an interconnected relationship among these domains. This pattern reflects how real-world CPR performance relies on a combination of factual understanding, situational decision-making, and personal readiness to act. The convergence of these domains within the instrument reinforces its theoretical foundations and supports its practical relevance for CPR education and assessment.

The practical implications of these findings are noteworthy. The questionnaire can serve as a useful tool for instructors and program evaluators seeking to assess learner progress before and after CPR training. Because the items performed strongly across reliability and validity metrics, the instrument can help identify specific areas in which learners may require reinforcement—such as scenario-based judgment or confidence in performing certain skills. It also offers value for curriculum developers who wish to strengthen evidence-informed training modules by relying on data-driven insights. Beyond educational settings, the availability of a standardized, validated assessment tool enhances comparability across research studies and training programs, supporting broader public health efforts to improve CPR competency in communities.

Despite these strengths, the study is not without limitations. The sample was relatively small and drawn from a single educational institution, which limits the generalizability of the findings to other populations or training contexts. Convenience sampling may also have introduced bias, as participants who chose to take part may differ in motivation or prior exposure to CPR compared to those who did not participate. Additionally, the skill-related domain relied on self-reported confidence, which may not always accurately reflect actual performance in real emergency situations. Future studies should aim to include larger and more diverse samples, incorporate direct observation or skill demonstration measures.

CONCLUSION

The findings of this study affirm that the CPR questionnaire possesses strong psychometric integrity and serves as a reliable measure of essential CPR-related competencies. Beyond its statistical performance, the instrument demonstrates practical value by offering educators and trainers a structured means of assessing the multidimensional components of CPR readiness, including factual understanding, decision-making under pressure, and perceived confidence in skill execution. The coherence among these domains reflects the integrated nature of real-world CPR performance, reinforcing the importance of assessment tools that capture both cognitive and behavioral aspects of emergency response.

The results also suggest several useful applications for CPR training environments. Educators can employ the questionnaire to diagnose learning gaps before and after training, guide the refinement of instructional strategies, and tailor support for learners who need reinforcement in specific areas. The strength of the instrument also makes it suitable for research contexts, particularly studies seeking to compare CPR competence across populations, monitor the impacts of curriculum innovations, or evaluate long-term learning retention. Future research would benefit from testing the instrument in more diverse settings, incorporating larger sample sizes, and including observational assessments to complement self-reported measures. Such work would help expand the generalizability of the findings and strengthen the link between measured competence and actual CPR performance.

Overall, the validated questionnaire contributes meaningfully to ongoing efforts to improve CPR education and strengthen community health preparedness. Reliable assessment tools are essential for ensuring that learners emerge from training programs with the knowledge, reasoning ability, and practical readiness needed to respond effectively in life-threatening situations. By supporting more accurate evaluation of CPR competence, this instrument plays a small but important role in enhancing emergency response capacity and, ultimately, improving survival outcomes in cardiac arrest events.

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